

## Chapter 2: EARLY HISTORY OF COMPUTER TECHNOLOGY

### THE ANALYTICAL ENGINE

In 1837, Charles Babbage described a steam powered, mechanical “engine” that predicted virtually everything computers are capable of doing today. He spent more than 34 years trying to build it. Made of brass, and at approximately 95 X 35 feet, it would not have been a laptop.

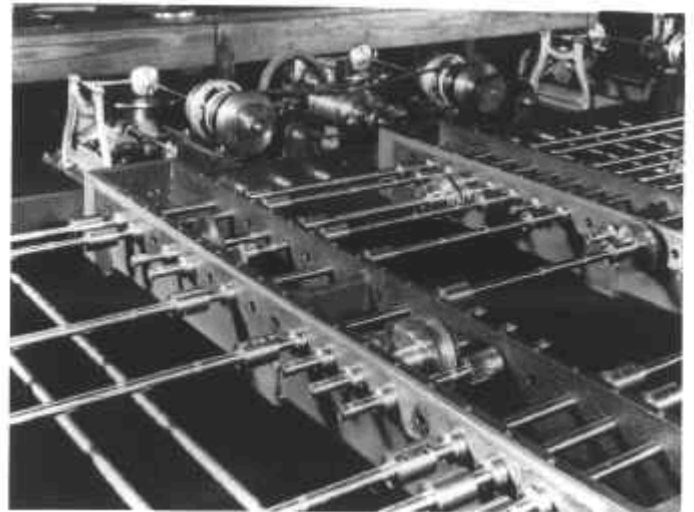
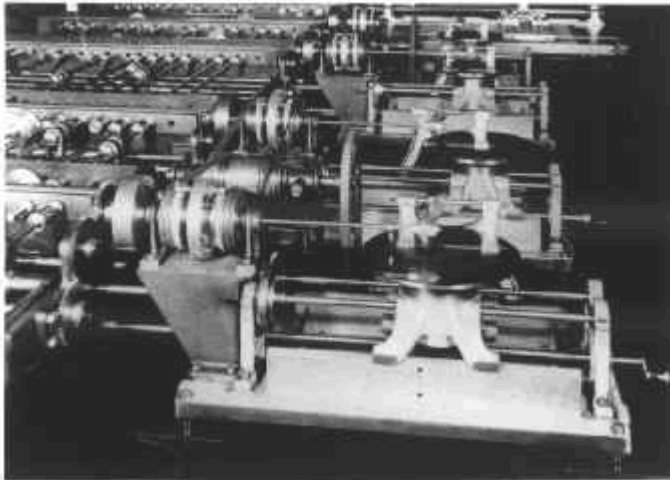
In the end, machining technologies of the time were not up to the task and the Analytical Engine was never completed. Nonetheless, according to computer technologists of the time and of the present, it would have worked.

The machine would have used punch cards for programming and would have applied a ten-based (decimal) system. It was designed with the memory to hold 1000 numbers of up to 50 digits.

### BUSH DIFFERENTIAL ANALYZER

In 1931 Vannevar Bush and a group of students at MIT, built a calculator capable of solving differential equations at +/- 1% accuracy. The machine called, “the Bush Differential Analyzer,” was purely mechanical, constructed of wheels and pulleys, filled a room and weighed 100 tons. It also contained more than a thousand vacuum tubes, several thousand relays, and more than 100 motors.

Differential calculations are time consuming and difficult, and being able to perform them with a programmable machine, even if the programming involved adjusting wheel tension, was very valuable. On the other hand, the analyzer was prone to failure toward the end of its analysis, losing all of its data up to that point. Still, this represents what is probably the first working, programmable (sort of) computer.

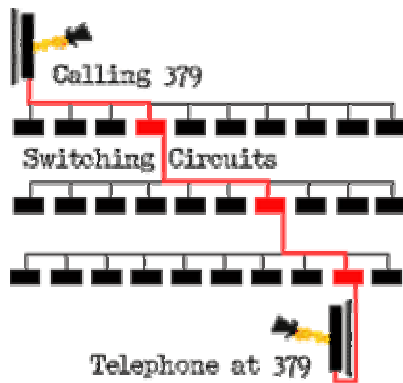


**Bush Differential Analyzer introduces computer technology that works, after a fashion.**

### Z3, First Working Programmable Computer

In 1941, Conrad Zuse created the first dependable computer. It was binary but contained floating point number capability. Programming was done with punched film.

The computer was still largely mechanical, but Zuse was able to get rid of the Babbage's gears by using telephone switching relays. Before the advent of digital switching, when people dialed a phone number, each number they dialed opened a relay that took them one step closer to opening a circuit to the final destination. Dial "1" and the "1" relay was opened. Dial "5" and the "5" relay is opened. In short, each telephone's open line resulted in a unique combination. In the Zuse computer, the combinations lead to numerical solutions.



This was done in Austria during WWII, and it should have been a benefit to the Nazis, but according to some historians, Americans and British bombers destroyed his early machines. Other historians suggest that Hitler dropped the project because he believed that the war was all but won, and he would not need the power of the computer.

Circuit switching works by having switches dedicated to specific numbers. Each telephone has a unique combination of switches.

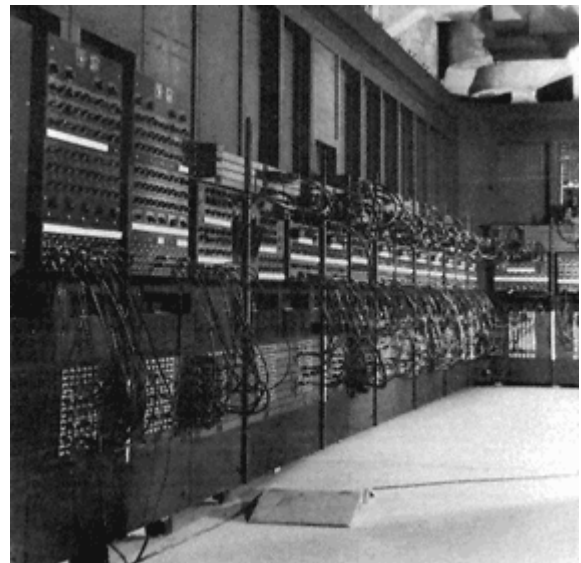
### ENIAC

In 1943, the WWII was well underway, and one of the important issues was to develop predictions for the trajectories of bombs and shells. The Ordnance Ballistic Research Laboratories was able to use a Bush Differential Analyzer but needed more programmability and dependability than the analyzer was able to provide. The lab proposed a larger, more powerful, and fully electronic machine. The resulting machine was begun in 1943 and completed and installed in 1946, and it became a significant breakthrough in computer technology.

Like the analyzer, the ENIAC filled a room, but unlike the analyzer there were no moving parts involved in solving equations. Instead, the machine used more than 17,000 tubes.

The tubes represented "gates" that worked in much the same manner transistors work in contemporary computers. In this case, the tubes represented "and" gates "or" gates and "flip flops."

The computer was programmed by



Looking like something out of a 1950s SciFi movie, this represents a single panel of the ENIAC.

connecting these gates with patch cords or switches.

## PROGRAMMING REVOLUTION OF ALAN TURING

In the early 1900s, “computers” were people who did calculations. But mathematics was largely based on faith that the axioms and theorems that the computers used



Alan Turing.

stood on a foundation of logic that could some day be understood and described. Mathematicians and logicians sought a process by which they could prove that every problem had an algorithm capable of solving it. For example, in the first decade of the 1900s Alfred North Whitehead and Bertrand Russell wrote the first three volumes of Principia Mathematica to provide a language capable of providing a logical foundation from which all solutions could be derived. Unfortunately, as they progressed, the logic of their language began to collapse. Kurt Gödel's incompleteness theory suggested that any complex logical structure such as that found in Principia Mathematica can never be complete and is logically unsupportable, and their fourth volume was never published.

Alan Turing contributed to this argument in 1933 with a suggestion that a purely logistic view of mathematics was inadequate. Mathematical propositions possess interpretations of which logic is only one. Although the above describes Turing's attitude toward mathematics, it also points to a certain openness in his thinking that leads to more important innovations for contemporary computing. For example, if mathematics is not purely logistic, it might be used for information exchange – communication.

Turing continued by creating a conceptual process that came to be called “the Turing Machine.” Conceptually, the Turing Machine includes a specialized program as one of its components. The programming occurs on a short bit of telegraphic tape designed to tell a machine how to make yes/no decisions. It is, however, a very small step from the concept of programming for a specialized purpose to programming for any specialized purpose.

Many historians suggest that before this, computers were nothing more than large calculators. Only with the advent of programming, did computers as we know them begin.